FIG.1

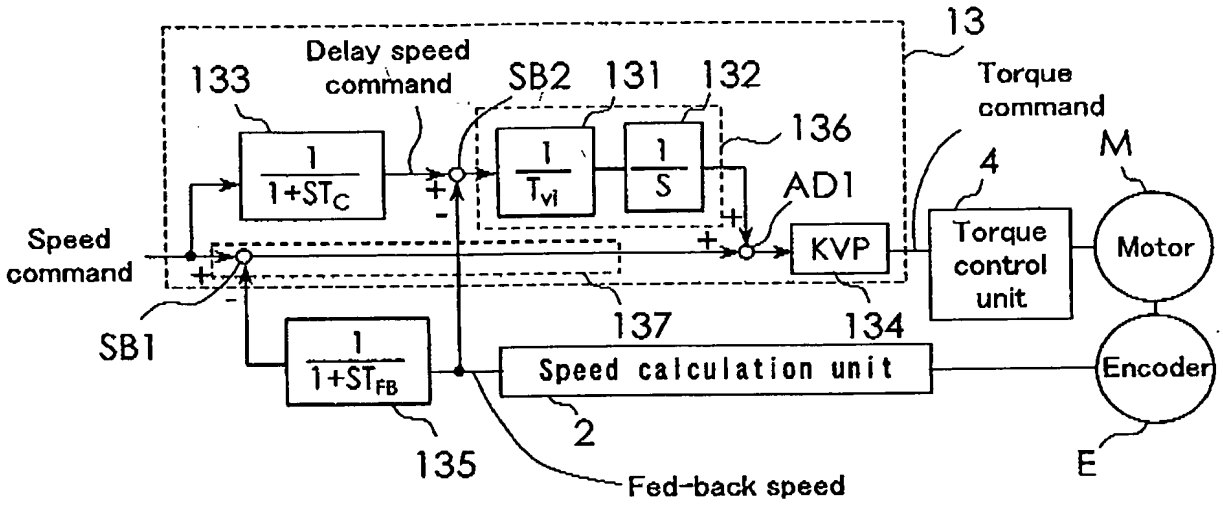
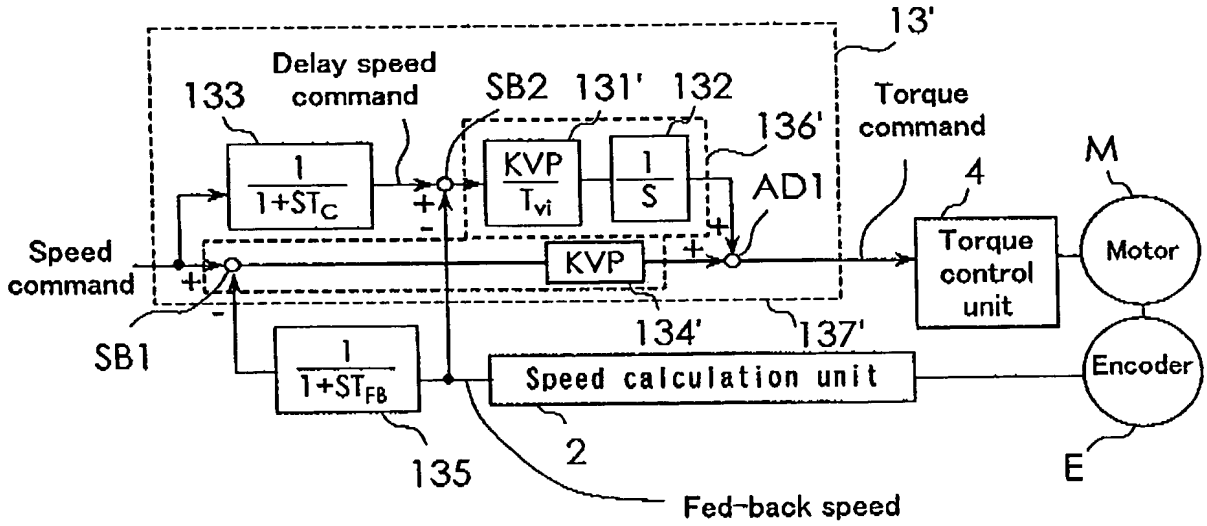
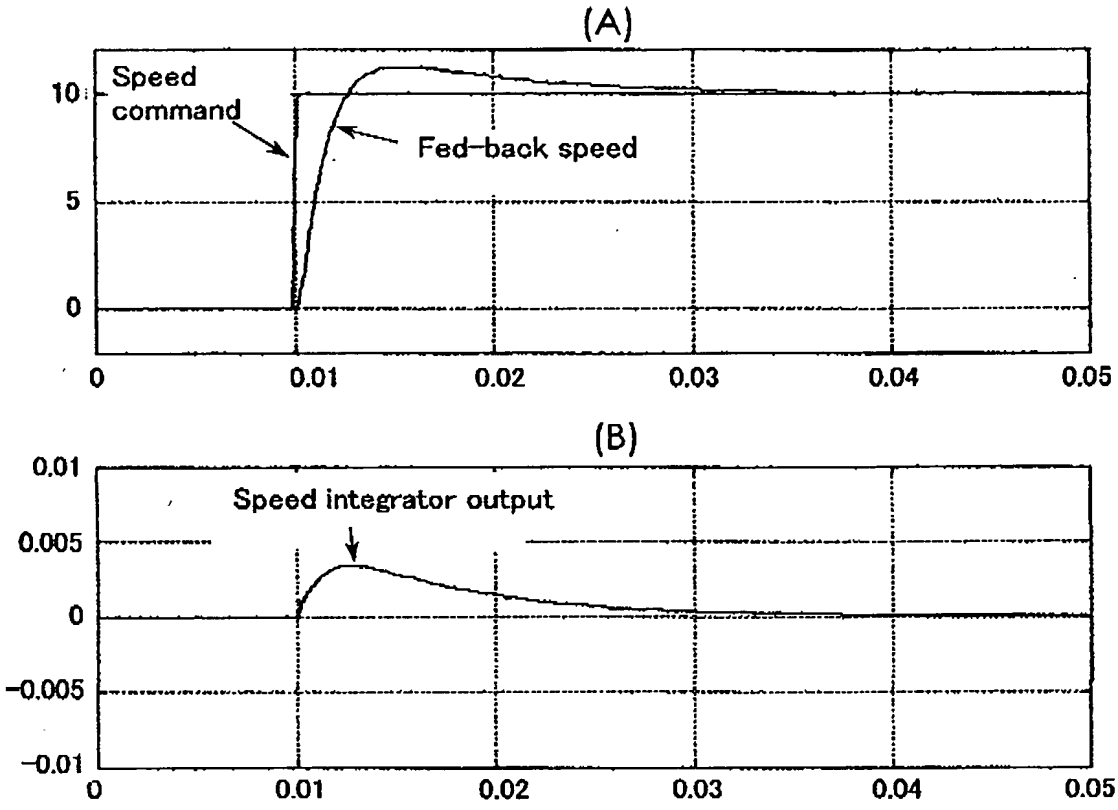

13
133
Delay speed command
SB2
131
132
136
Torque command
4
M
AD1
Speed command
KVP
Torque control unit
Motor
SB1
137
134
Speed calculation unit
Encoder
2
135
Fed-back speed
E

FIG.2


13'
133
Delay speed command
SB2
131'
132
136'
Torque command
4
M
AD1
KVP
Speed command
KVP
Torque control unit
Motor
SB1
134'
137'
Speed calculation unit
Encoder
2
135
Fed-back speed
E

10/549727

FIG.3



10/549727

FIG.4

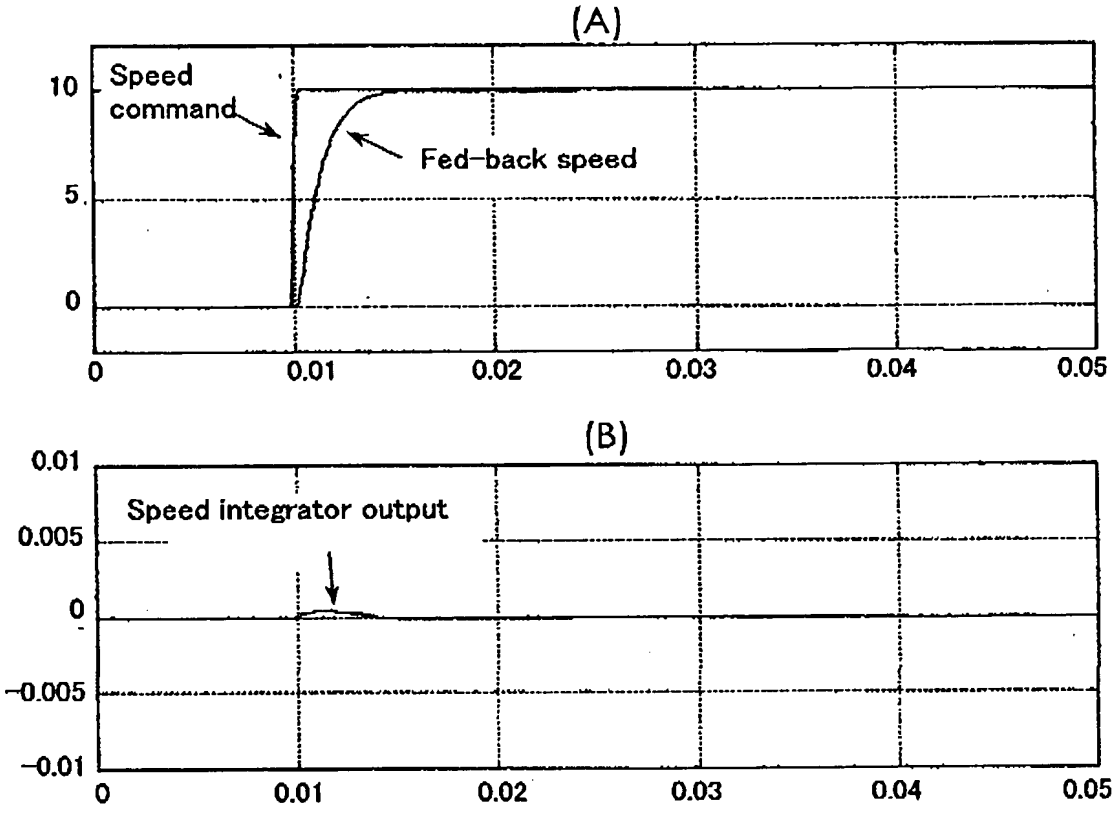


FIG.5

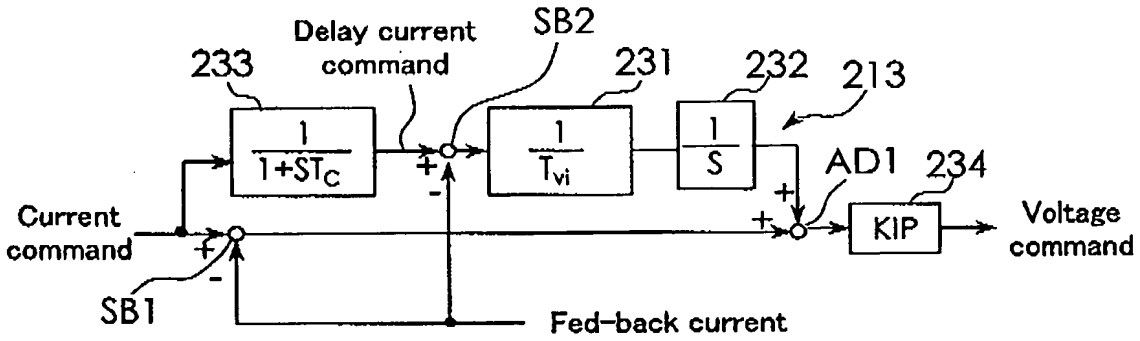

Delay current command
SB2
233
231
232
213
1/(1+STc)
1/Tvi
1/S
AD1
234
KIP
Current command
Voltage command
SB1
Fed-back current

FIG.6

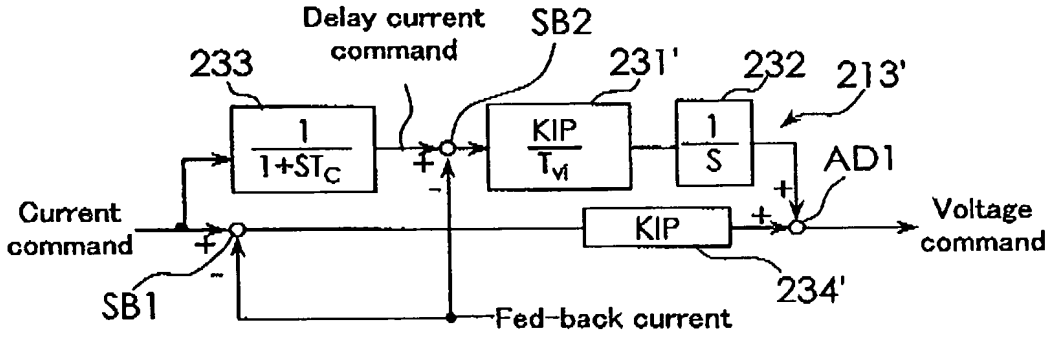
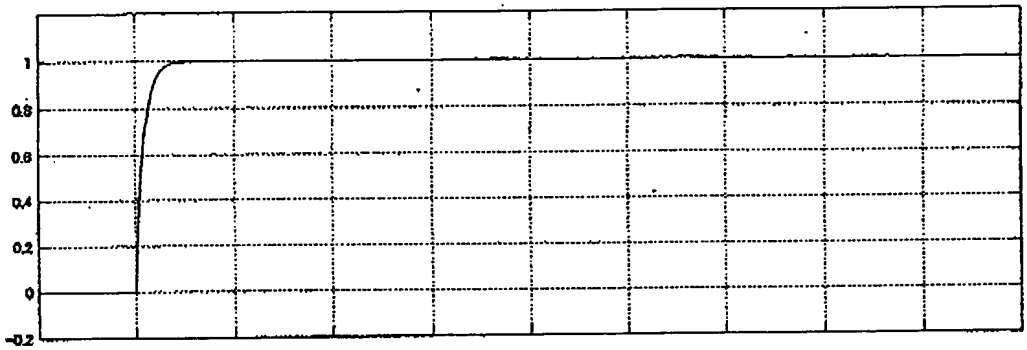
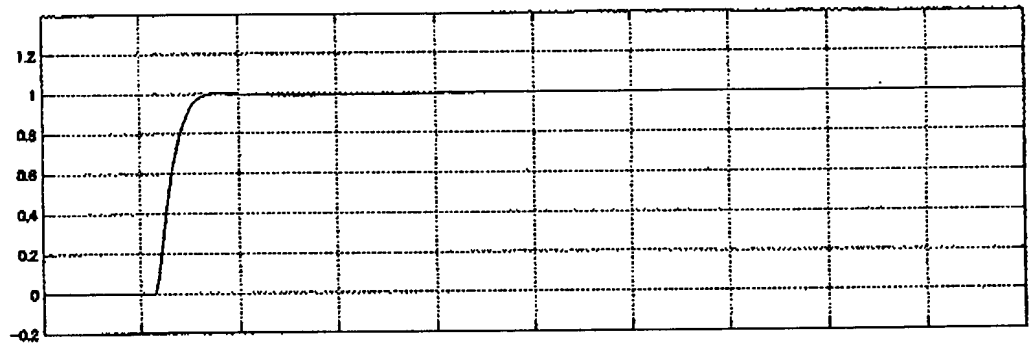

Delay current command
SB2
233
231'
232
213'
1/(1+STc)
KIP/Tvi
1/S
AD1
Current command
KIP
Voltage command
234'
SB1
Fed-back current

FIG.7

(A)


1
0.8
0.6
0.4
0.2
0
-0.2

(B)


1.2
1
0.8
0.6
0.4
0.2
0
-0.2

(C)

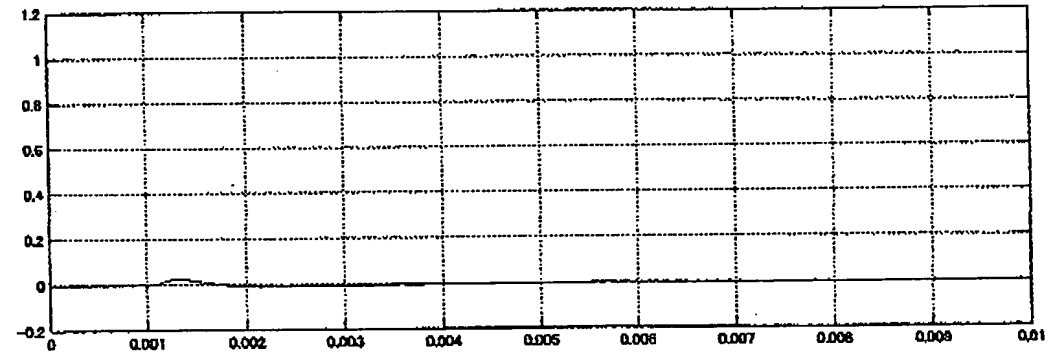
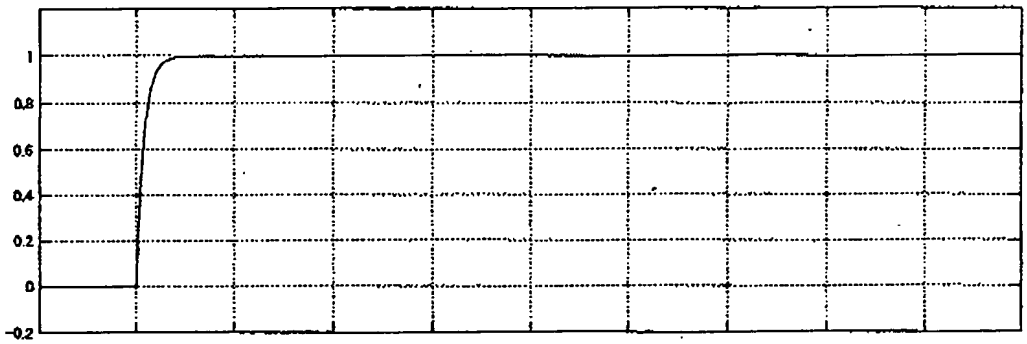
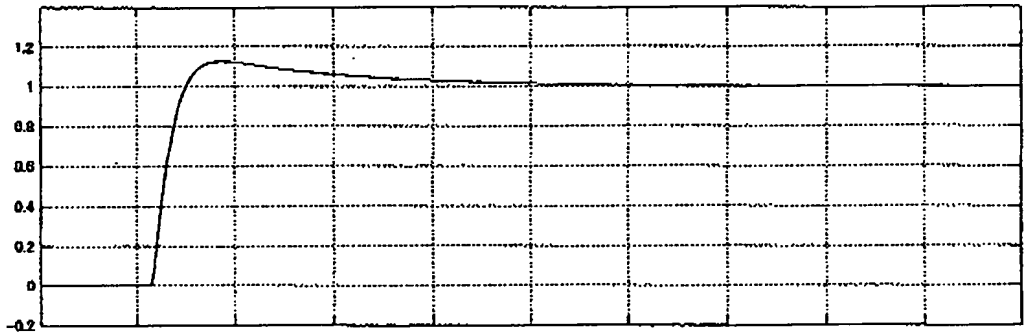

1.2
1
0.8
0.6
0.4
0.2
0
-0.2
0
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
0.009
0.01

FIG.8

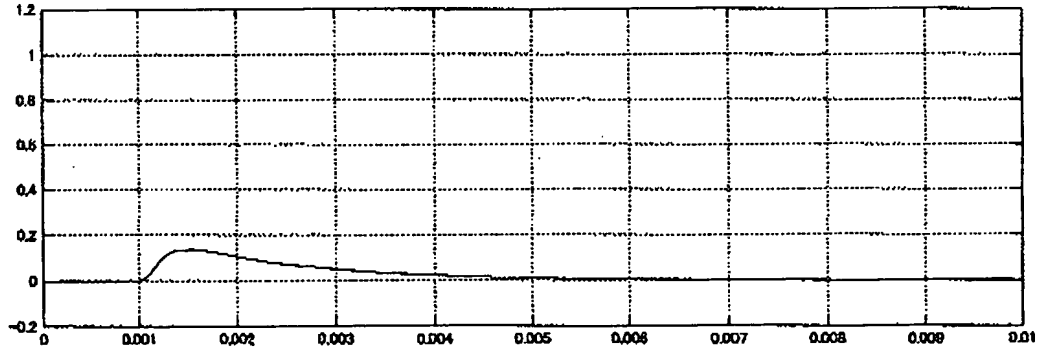
(A)


1
0.8
0.6
0.4
0.2
0
-0.2

(B)

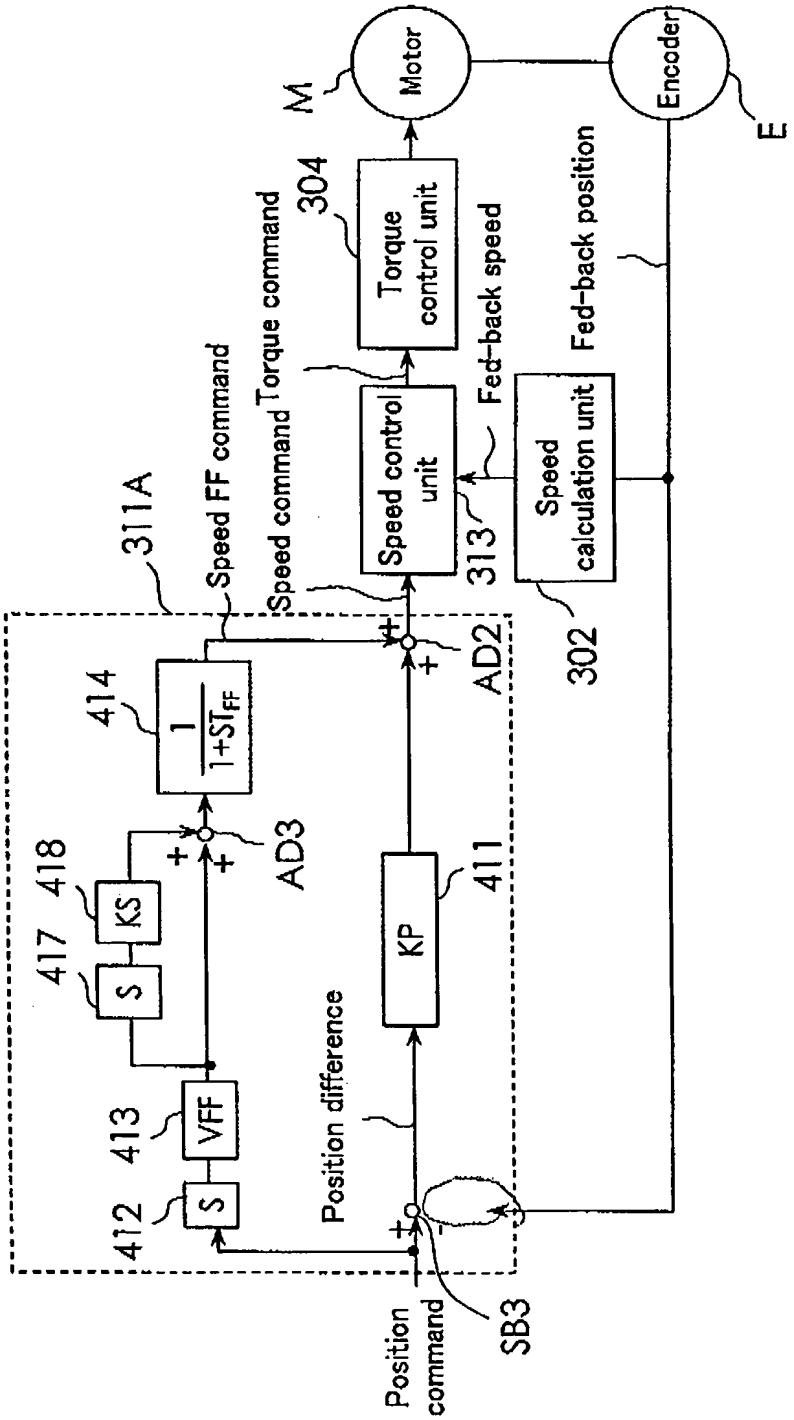

1.2
1
0.8
0.6
0.4
0.2
0
-0.2

(C)


1.2
1
0.8
0.6
0.4
0.2
0
-0.2
0
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
0.009
0.01

10/549727

Fig.9



10/549727

FIG.10

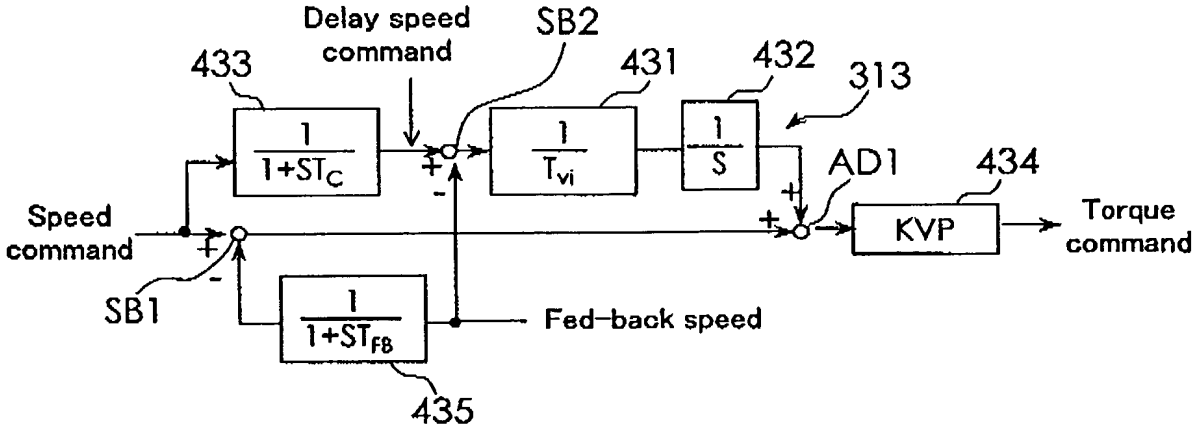
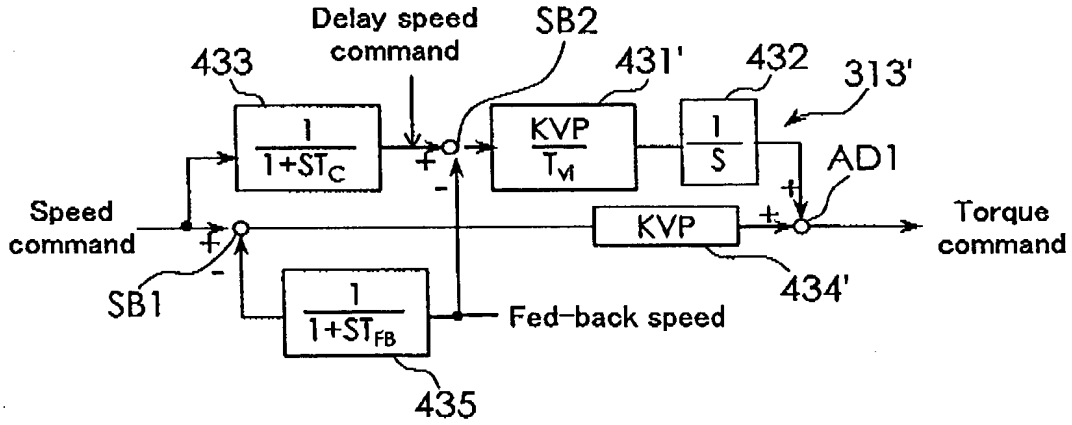


FIG.11



10/549727

Fig.12

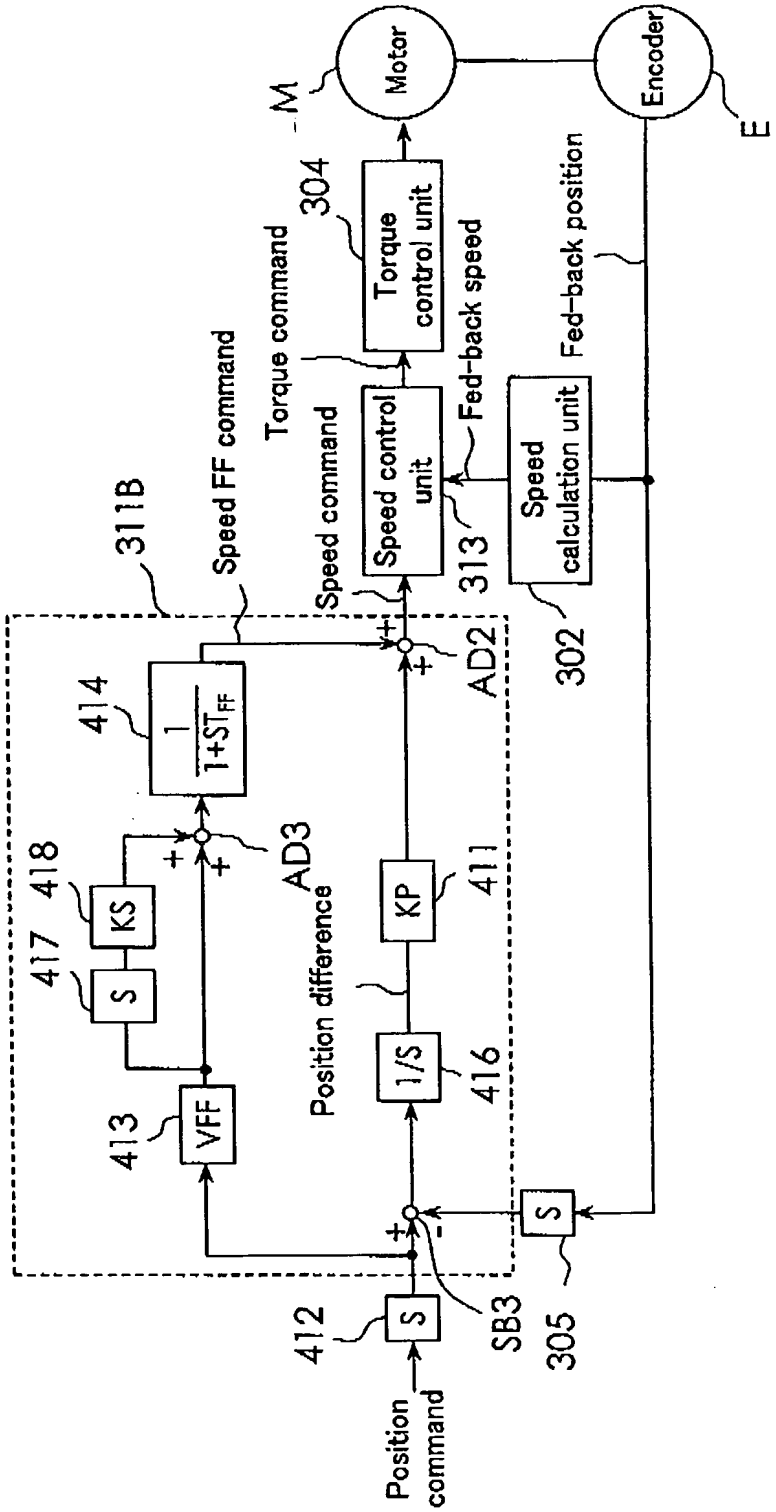
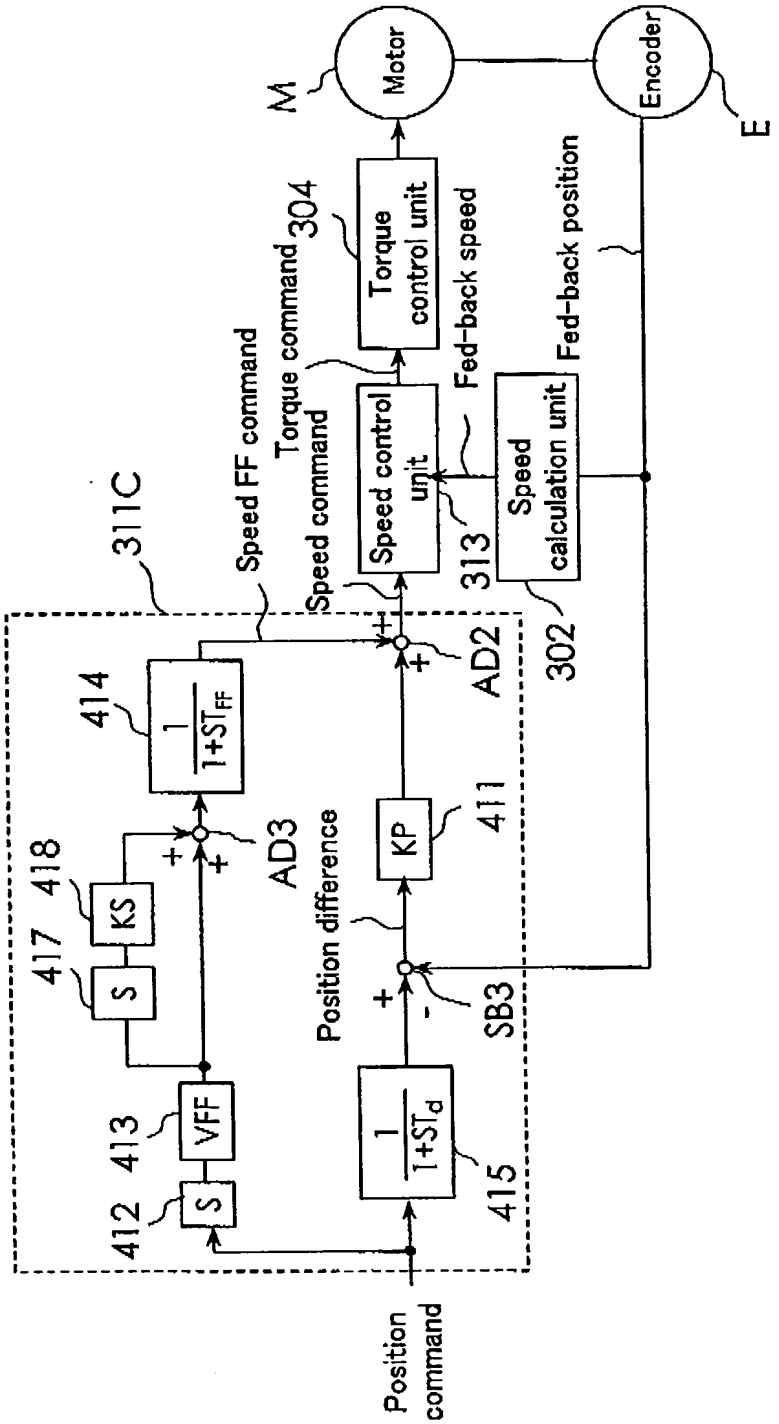
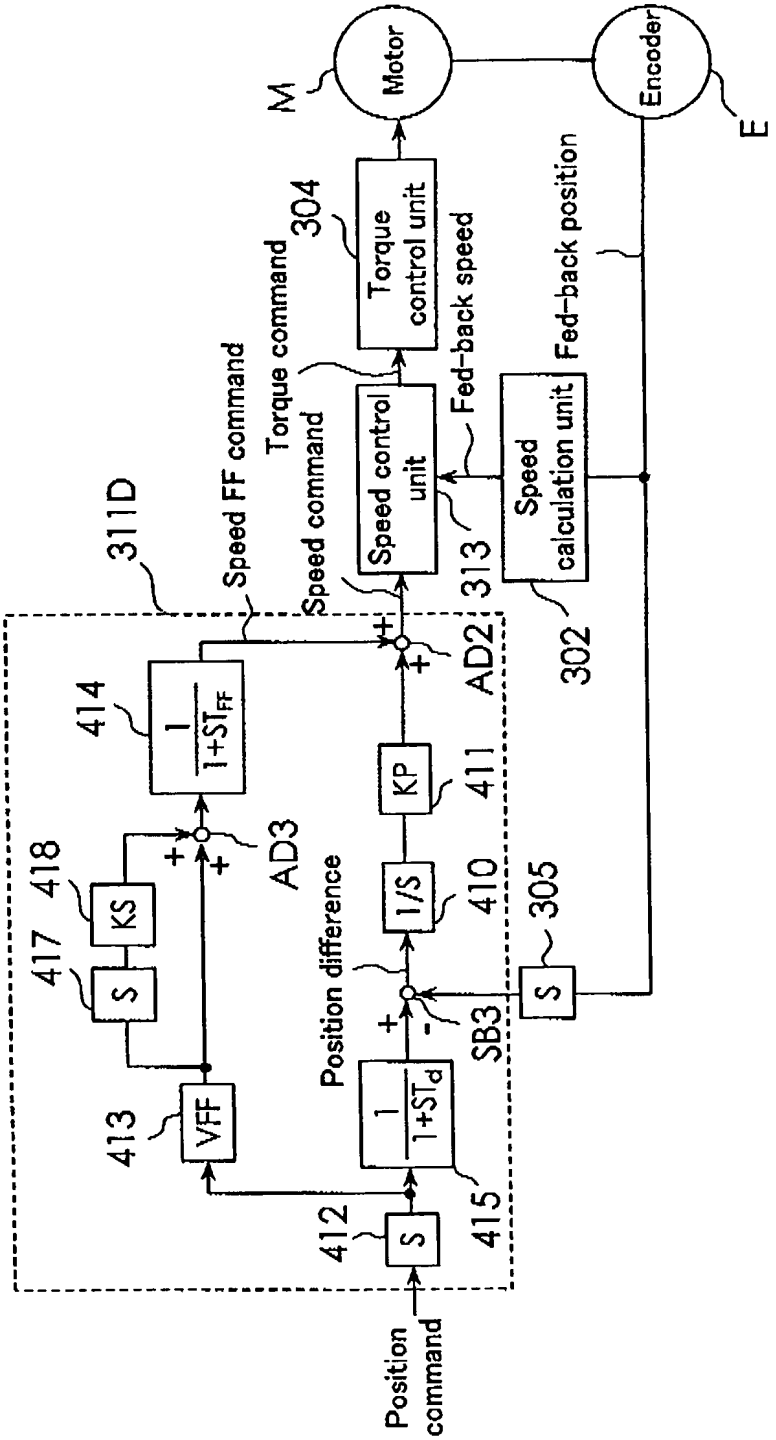


Fig.13


M
Motor
Encoder
E
304
Torque control unit
Torque command
Fed-back speed
Fed-back position
313
Speed control unit
Speed calculation unit
302
Speed FF command
Speed command
311C
AD2
414
1/(1+ST_FF)
AD3
418
KS
417
S
411
KP
Position difference
SB3
413
VFF
412
S
1/(1+ST_d)
415
Position command

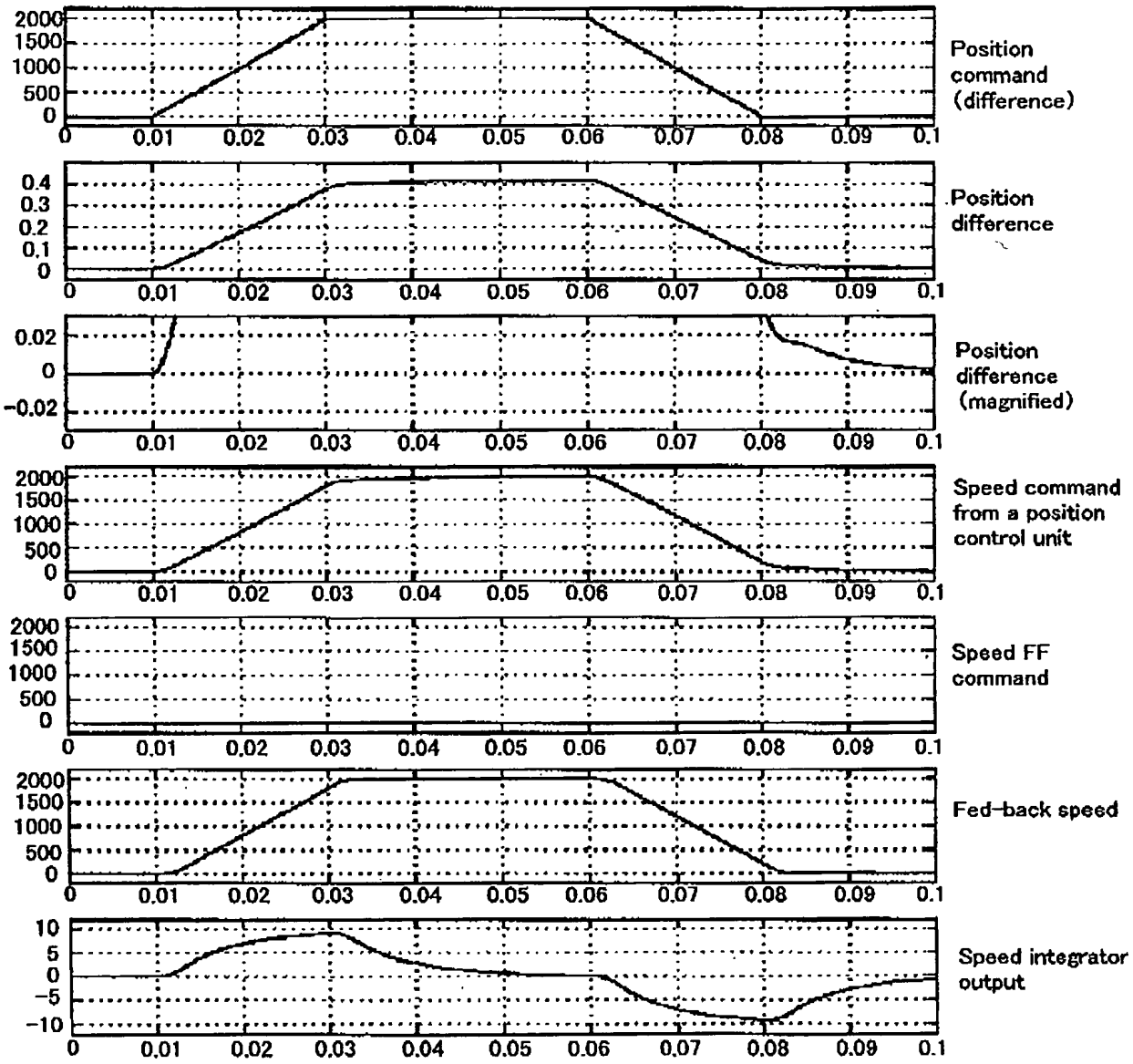
10/549727

Fig.14



10/549727

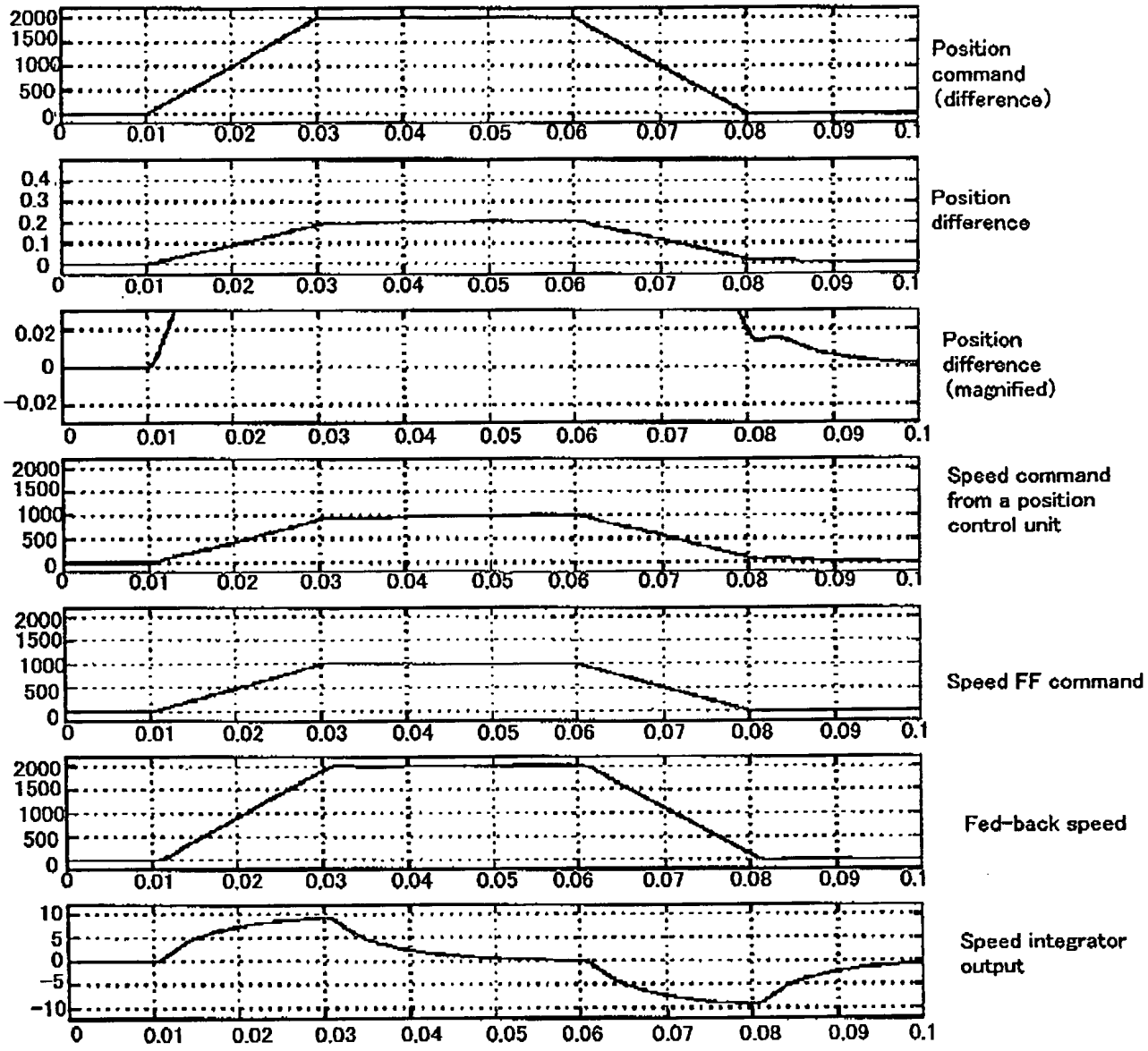
FIG.15



(Feed forward gain 0%)

10/549727

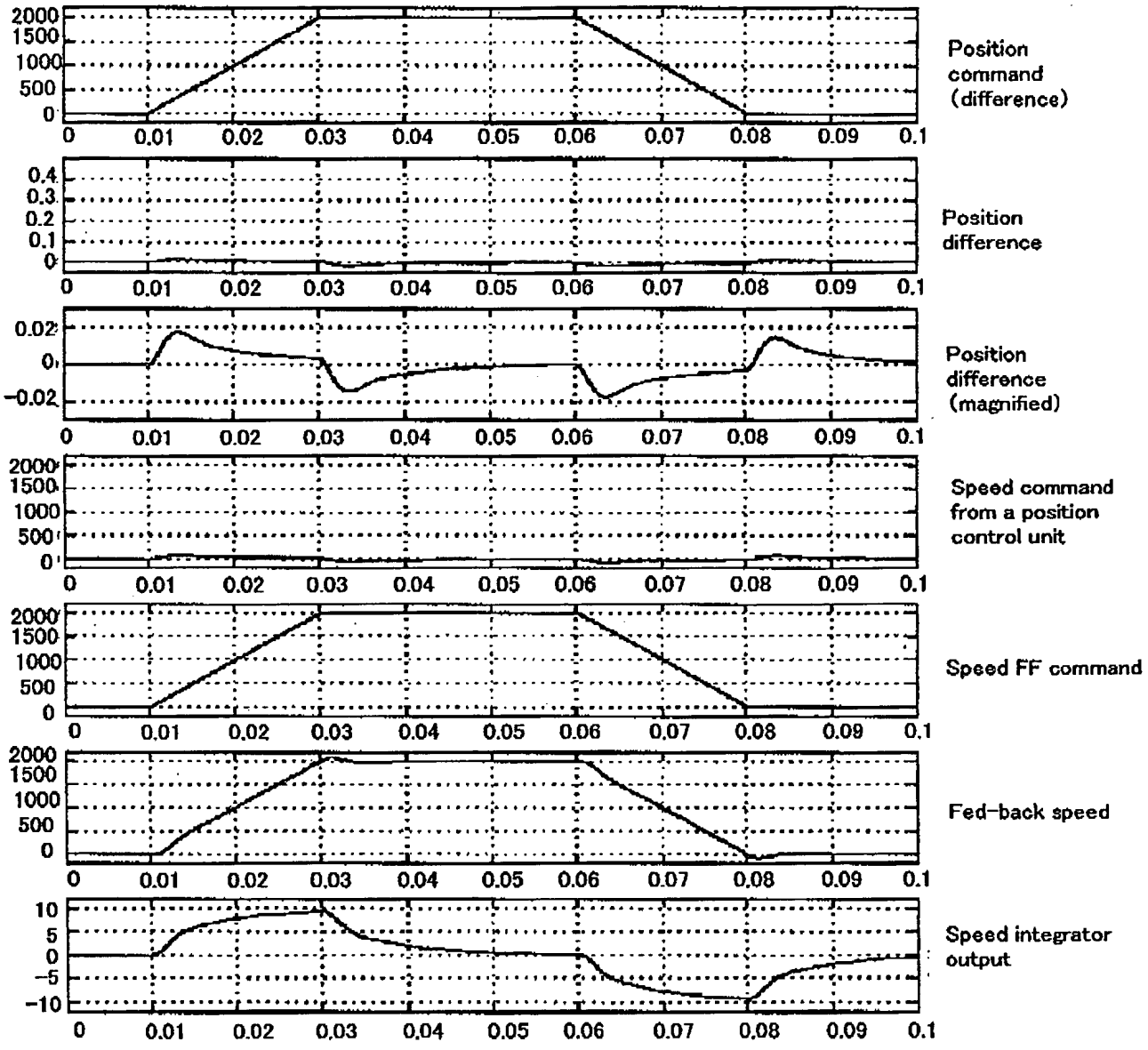
FIG.16



(Feed forward gain 50%)

10/549727

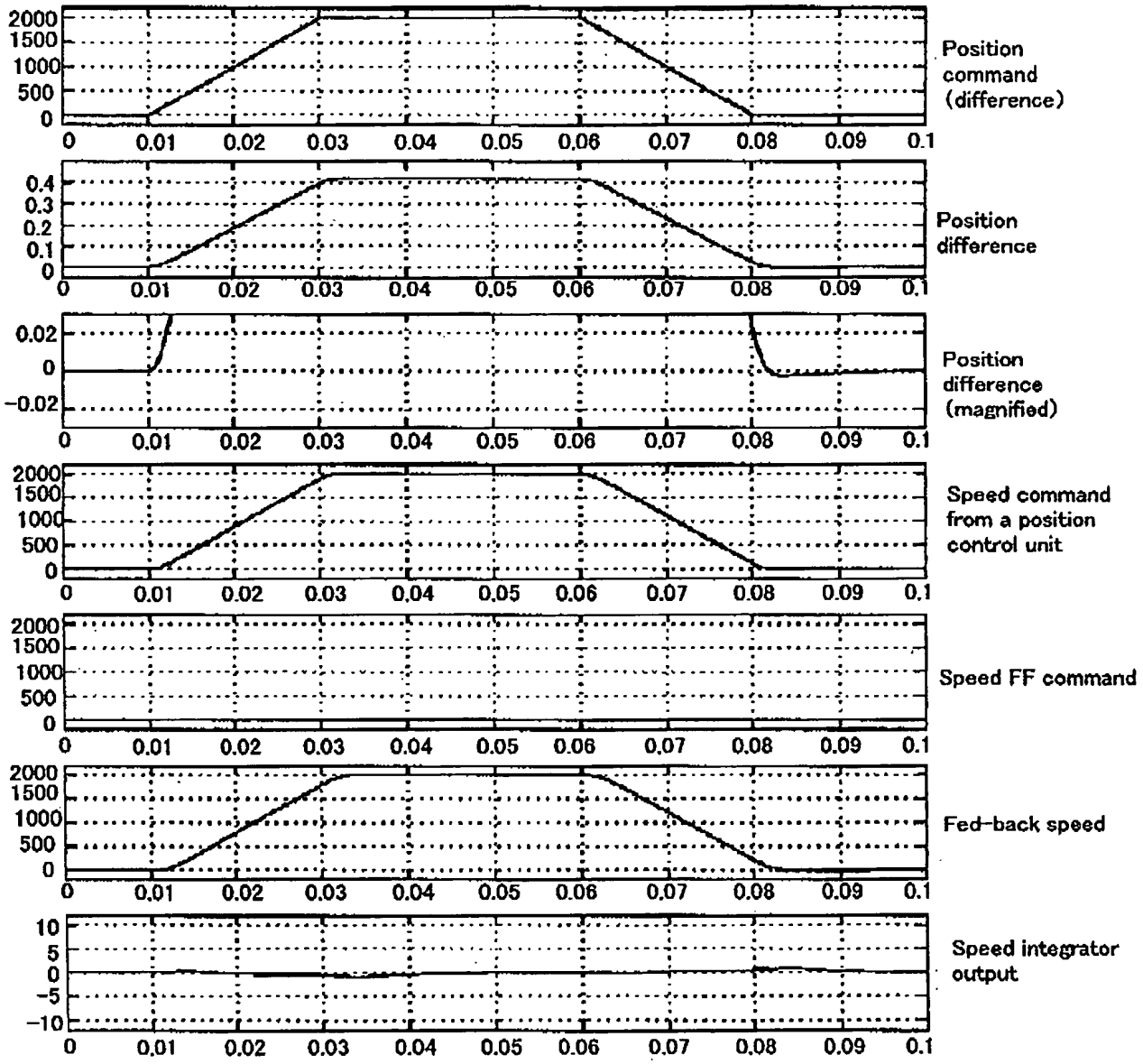
FIG.17



(Feed forward gain 100%)

10/549727

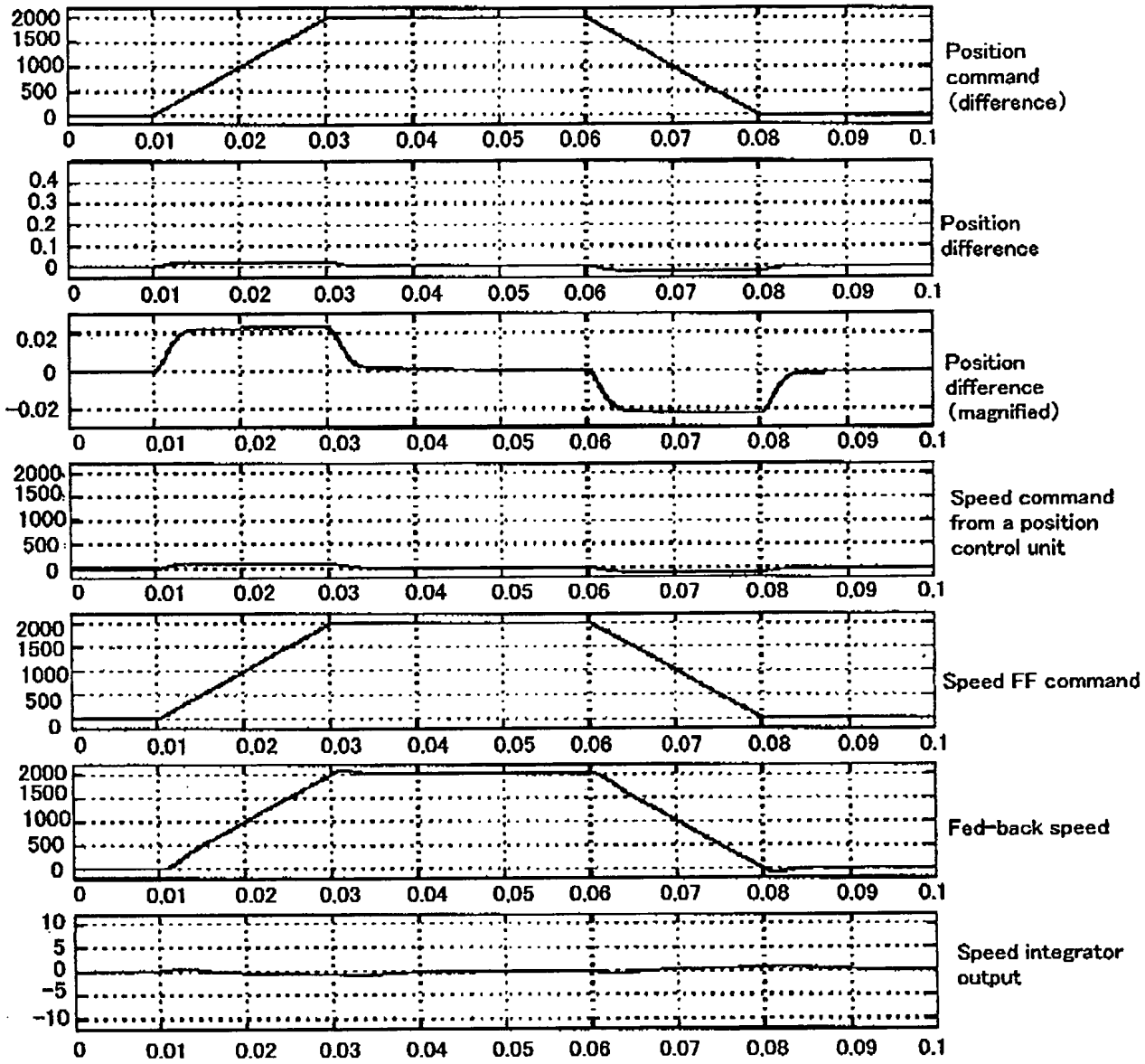
FIG.18



Feed forward gain 0%
A delay compensation low-pass filter in the speed control unit is applied.

US549727

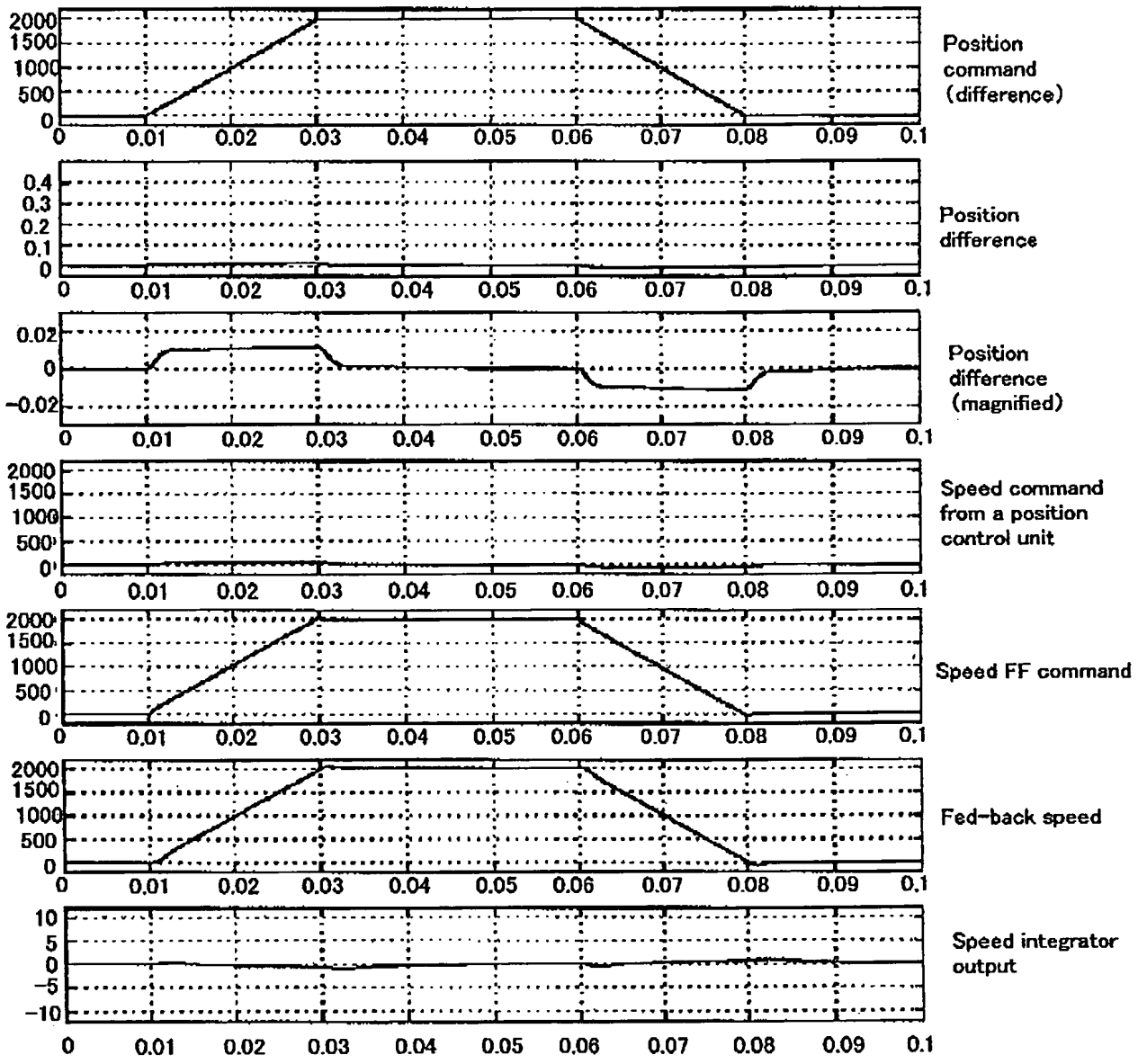
FIG.19



Feed forward gain 100%
A delay compensation low-pass filter in the speed control unit is applied.
Differential gain 0

10/549727

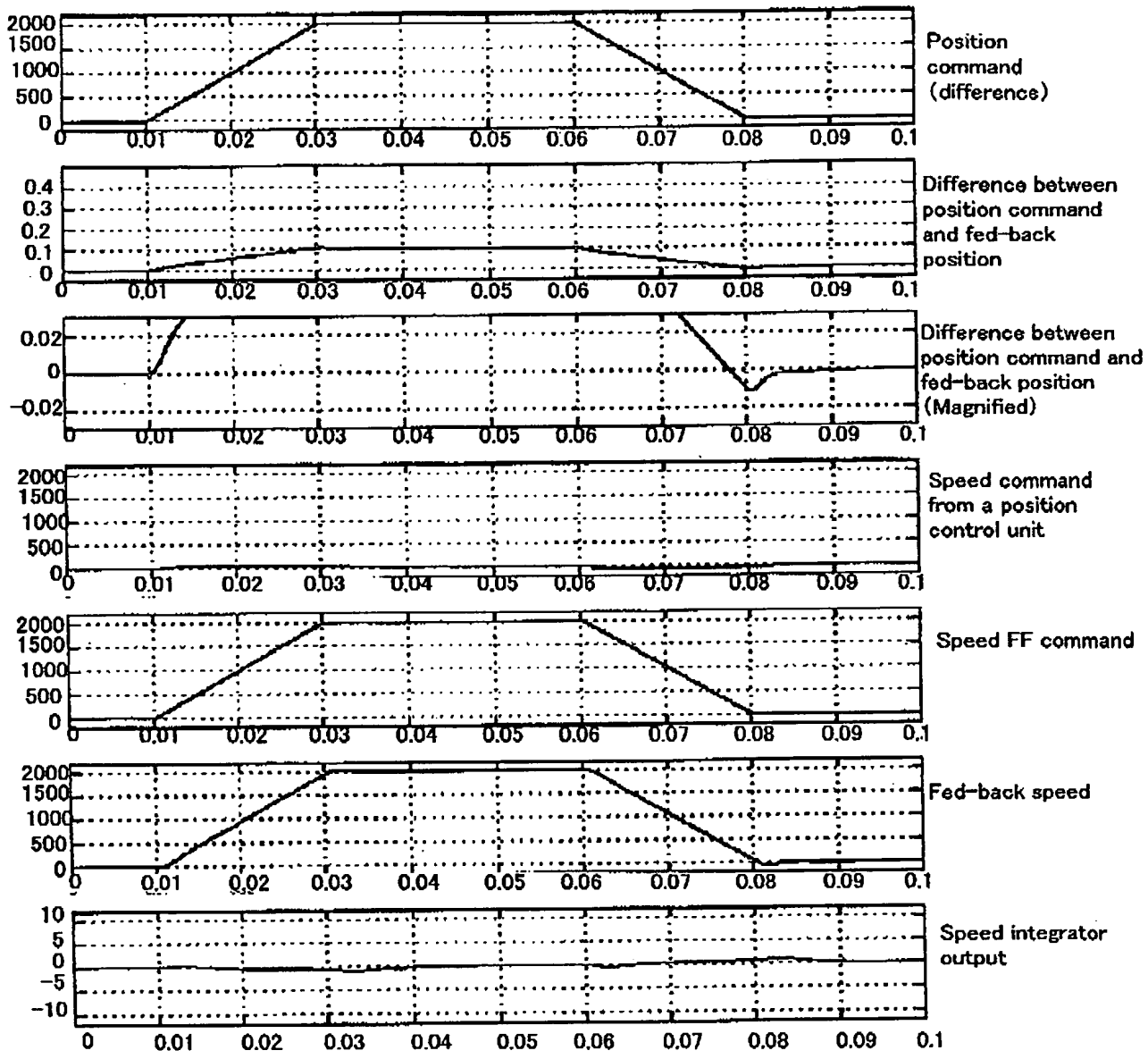
FIG.20



Feed forward gain 100%
A delay compensation low-pass filter in the speed control unit is applied.
Differential gain is set.

10/549727

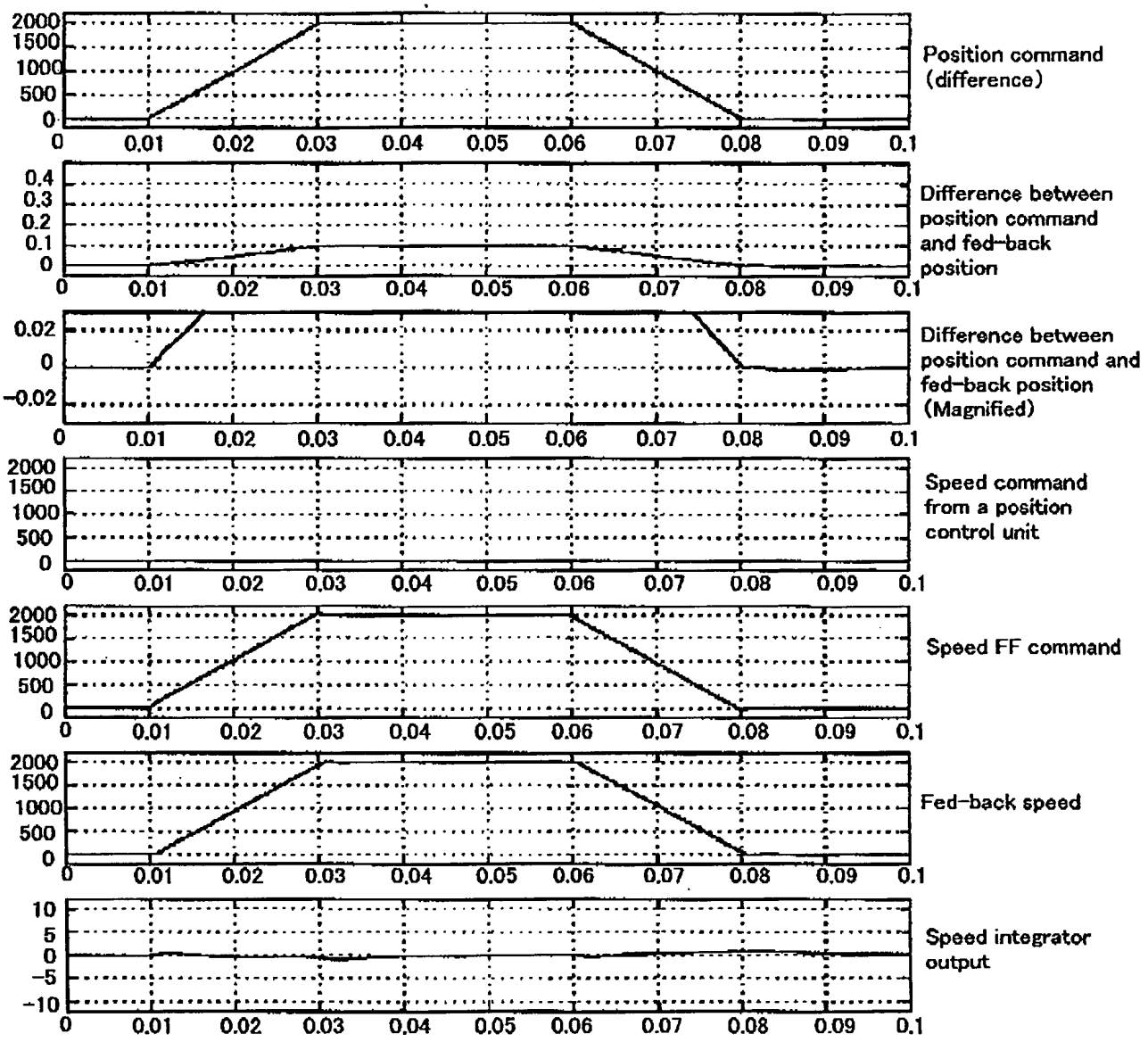
FIG.21



Feed forward gain 100%
A delay compensation low-pass filter in the speed control unit is applied.
Differential gain 0
A delay compensation low-pass filter in position control unit is applied.

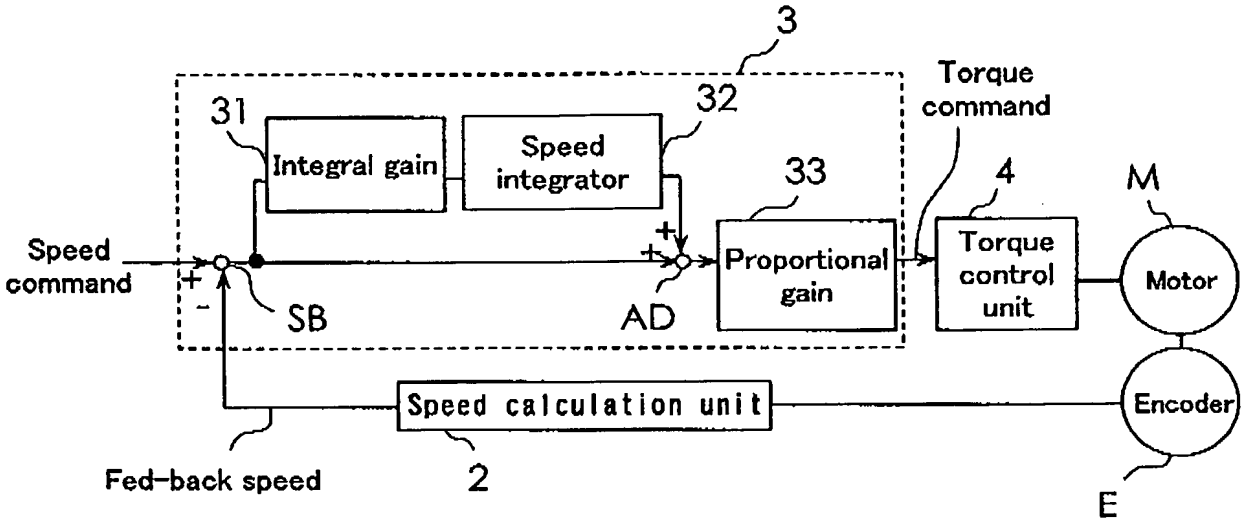
10/549727

FIG.22



Feed forward gain 100%
A delay compensation low-pass filter in the speed control unit is applied.
Differential gain is set.
A delay compensation low-pass filter in position control unit is applied.

FIG.23


3
31
Integral gain
Speed integrator
32
33
Torque command
4
M
Speed command
+
-
SB
+
+
AD
Proportional gain
Torque control unit
Motor
Encoder
Speed calculation unit
Fed-back speed
2
E

10/549727

FIG.24

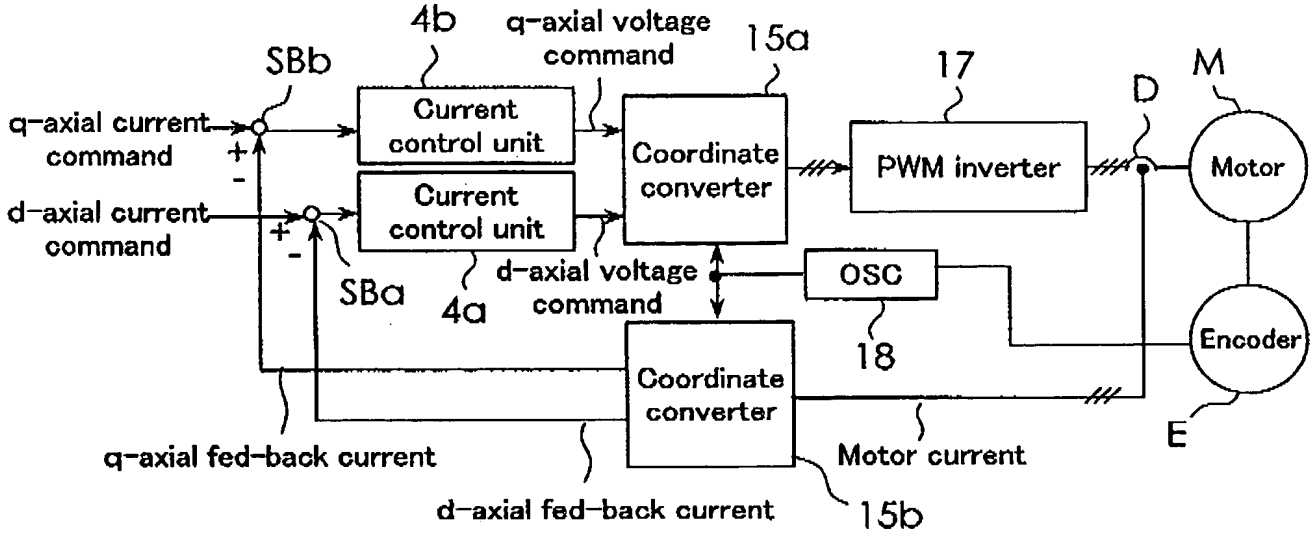
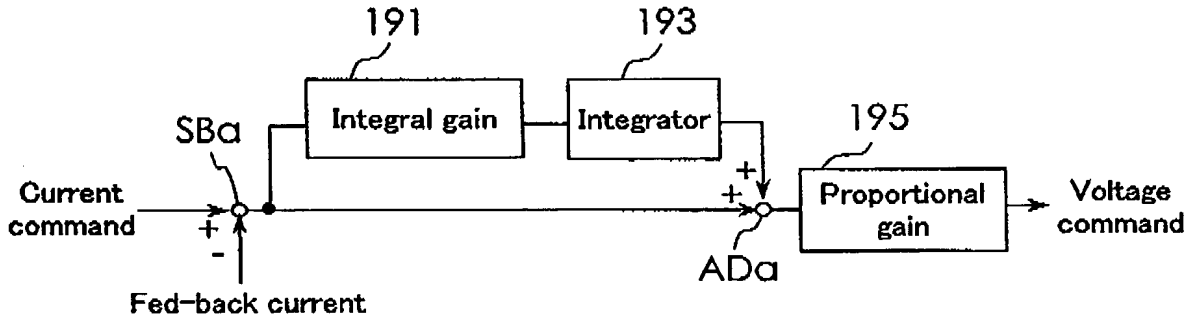


FIG.25



10/549727

FIG.26

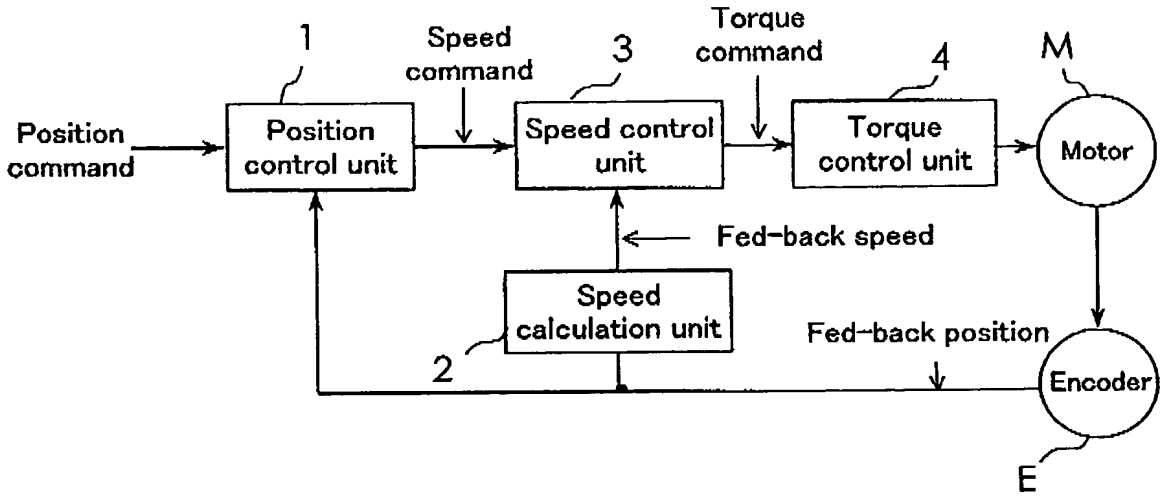


FIG.27